Article
Quantifying the Impacts of Urbanization on Urban Agriculture and Food Security in the Megacity Lahore, Pakistan

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Abstract: As a response to food security, urban agriculture is essential for sustainable development. The primary goal of this study is to provide the basic formulation and theoretical knowledge for sustainable urban agriculture by analyzing the impact of urbanization on urban agriculture and food security. For the food security assessment, the variables included food consumption and quality of food as the independent variables, and monthly income of local dwellers as the dependent variable; these were considered for the regression analysis and statistical analysis. The food security assessment was checked and expressed using regression values of R, which was 0.857, and an adjusted R square, with a value of 0.728. The results show extensive change in food security issues and land use due to urbanization causes, large-scale damage to agricultural land in the area, and loss of biodiversity, which threaten food security by converting natural land into built-up areas. The study concludes that urban agriculture is a fundamental environmental activity to ensure food security by increasing food production for locals and improving urban biodiversity.

Keywords: environment; consumption of food; food security; urban agriculture; urbanization

1. Introduction
Agriculture involves breeding plants and animals to meet human needs for food [1]. It is a deliberate effort to modify a portion of Earth’s surface by cultivating crops and raising livestock for sustenance and economic gain [2]. Urban agriculture, or peri-urban agriculture, is the process of growing, transforming, and circulating food in urban or peri-urban areas of city boundaries or urban fringes [3]. The rapid rate of urbanization worldwide threatens the agricultural industry by converting natural land into built-up areas for settlement [4]. The rate of urbanization is increasing gradually without planning, particularly in the least-developing nations around the world, and this phenomenon is more dominant in megacities [5]. In megacities of developing nations, the rate of consumption of food is high due to larger populations and faster growth rates, as well as migration from rural to urban areas. These factors threaten the food cycle (growth, provisions, availability, and consumption) indirectly and food security in the region of the Global South [6,7]. High food demand, with a lower production ratio, also increases food prices and creates issues for poor urban people due to their low income, and so this study proposes to investigate this phenomenon.

In the study area, the urban area of Shahdara Town, Lahore, the major platforms for agricultural activities and urban farming include kitchen gardens, fruit production, and domestic and livestock farming [8]. The basic food products of this type of farming include eggs, fruits, vegetables, milk and dairy, meat, and poultry. All of these food products are the basic agricultural products of the study area. For food security measurements, the...
variables, including consumption of food per month, quality of food, and monthly income of local dwellers, were considered for the regression analysis.

The current study aims to develop and analyze the impact of urban agriculture on the local food cycle in terms of food production, consumption, and distribution. Very few past studies associated with urban and peri-urban agriculture have been conducted, particularly in developing nations [9,10]. Therefore, this study tries to provide some basic insights into urban agriculture in the Shahdara Town of Lahore, Pakistan. Along with food security, this study also investigates the impacts of urban growth, its land use changes on local habitats, the type of agriculture activities in the area, and biodiversity in terms of land use and land cover change. Finally, the study also attempts to examine the associations between food consumption, the monthly income of the local population, and its relation with food security (food provision, consumption, and distribution).

2. Review of Literature

Urban, or peri-urban, agriculture is a residual form of agrarian agriculture in growing cities, although there is a lack of a universally accepted spatial definition of what peri-urban means [11]. However, peri-urban refers to the area near the city boundary or urban fringes where we can see a land use pattern, including settlements and agricultural land, which is more dominant in the least-developing countries [8]. According to the definition of the Food and Agriculture Organization of the United Nations, urban and peri-urban agriculture are the practices within urban boundaries or urban fringes that are associated with agricultural outputs and yields. These outputs may relate to food distribution, transformation, marketing, or cycling. However, this area is explained as a transitional zone between rural and urban areas. On the other hand, peri-urban is an area with a lower population density and less urban infrastructure, as in the case of our study area. Despite high regard for contributing to the vibrant urban food system, the theme of urban agriculture in the food cycle still remains unclear [12].

Food security indicates availability and personal approachability, including affordability [13,14]. Food security involves providing food with proper nutrition to every person in a community or family [15]. Previous studies have documented that food security was of concern to humans 10,000 years ago, and key authorities in ancient Egypt and China released food from storage during times of drought [11,13,15]. At the World Food Congress in 1974, the word “food security” was introduced, with a focus on food supply [16]. Food security is also “the availability of adequate, nutritious, diverse, moderate and balanced food at all times to sustain steady growth on food consumption, offsetting fluctuations in production and prices”. The closing statement of the World Food Summit 1996 stated that food preservation “appears in the material and economic path that all people have an approach to adequate, safe and nutritious food at all times to accommodate their nutrient needs and food preferences for an effective and quality life” [17].

Family food security exists when all family members have equal opportunity to access suitable food at all times to achieve a positive and healthy life. Food-safe people do not live in fear of hunger [18]. On the other hand, according to the US Agriculture Department, food uncertainty is a “limited or uncertain food supply for adequate and secure food, or finite or uncertain ability to obtain acceptable food in a socially acceptable manner” [19]. Due to different danger factors, including drought, fuel shortages, economic instability, shipping disruptions, and war, food preservation encompasses flexibility for forthcoming disruptions that cause a lack of access to critical food supplies within a region. Between 2011 and 2013, it was predicted that 842 million people were suffering from continual hunger. The Food and Agriculture Organization of the United Nations (FAO) identifies the four pillars of food preservation as availability, access, stability, and utilization [20]. The United Nation recognized the right to food in the “Human Rights Declaration” of 1948 and noted the importance of providing all other benefits. The “1996 World Summit on Food Security” announced that “food should not be use as a tool for economic and political strategy” [21].
According to the United States Department of Agriculture (USDA), urban or peri-urban agriculture involves the development of various economic, environmental, and social benefits for the surrounding community [22]. It can further involve animal farming, aquaculture, agroforestry, horticulture, and honeybee farming. Urban or peri-urban agriculture can follow different stages and phases of the biological, economic, and social development of an area [23].

It is a social movement for continuous associations; biological growers, “foodies”, and “locators” form a civil network based on a familiar natural and community holistic spirit [24]. These networks can be developed with proper institutional backing and unified into provincial town plans as a “transition municipality” campaign for continuous urban progress. Hand food preservation, income generation, and nutrition are the primary desires for this approach [25]. In other cases, a more direct approach to fresh vegetables, fruits, and meat commodities through urban agriculture can upgrade the food safety and food security [26].

Urban gardens are often society-run farms that aim to upgrade community relations through the provision of green infrastructure and also provide agricultural awareness to people living in urban areas [27]. These gardens are tiny, ranging from a small plot in individual yards to extensive gardens that span several acres. In 1996, a description by the United Nations predicted that more than 800 million people globally were growing food and raising these gardens in urban areas.

Urban or peri-urban agriculture is the crop and livestock production in towns and cities’ boundaries [28]. According to UNO reports, about 200 million people are engaged in peri-urban and urban agriculture, and allied businesses contribute to the food supply to 800 million residents [21]. Peri-urban agriculture around the city is an extra form of agriculture in boundary areas (a transition area between the urban and rural boundaries of the city). The peri-urban, or urban agriculture, sum of all the activities performed is the area or transition zone between urban and rural areas [29]. Therefore, these are not urban or rural lands because of limited agriculture and natural land [30]. The present objective was to analyze urban and peri-urban agriculture and its effect on urban food security. The study determined the area (transition boundary: Shahdara Town), production, and consumption ratios, and how much of the local population was involved in the growing of different food items.

Pakistan is an agricultural country with high food prices [31]. The reason behind this is that the production ratio of products does not meet the demands. On the other hand, Pakistan has achieved the latest technologies in the agriculture sector along with a well-established research infrastructure. Despite these issues, there is a hindrance to developing a reliable urban agriculture system in Pakistan. As a result, the prices of agricultural products shoot up. Modern urban agriculture practices can increase the ratio of agricultural products and decrease their prices, even in urban fringes. It will accelerate the export of value-added agricultural and livestock products. As a result, indirectly, more foreign exchange will be earned by exporting these products. Therefore, initiating urban and peri-urban agriculture in Pakistan is necessary today.

The core concept of all these descriptions is understanding the role of urban or peri-urban agriculture in food production around the world in urban regions. This general definition contains the generic term “agriculture” and identifies the most common agricultural and horticultural forms in the countryside. Sometimes peri-urban agriculture is also discussed as an aspect of urban agriculture in some respects [29]. Although few scholars discuss the gardens and farms in the downtown area, other scholars include agricultural activities being studied in peri-urban regions [32–34].

3. Methodology

3.1. Study Area

Shahdara Town, Lahore, is an ancient and congested urban/peri-urban transition boundary of Lahore, Pakistan. The town is facing a high settlement rate due to migration
from surrounding areas [35]. This study investigates how the natural land cover in this area was converted into urban built-up, which is also proven by a past study [36]. This un-sequenced, unbalanced, and fast urban sprawl threatens urban agriculture and food security in the town [37]. Unplanned urban growth leads to discontent, economic and political instability, and unplanned built-up in form of urban expansion. Figure 1 shows the study area’s land use scenarios and land cover change. Even the whole city of Lahore faces increasing and rapid population growth due to the high birth rate and migration from surrounding areas towards the city. This un-sequenced and unplanned settlement in peri-urban fringes of the city converts the natural land into built-up area.

Figure 1. Map of study area: Shahdara Town, Lahore, Pakistan.

There is a strong need to examine the impacts of land use change on local environment for urban sustainability and environmental development. Figure 1 shows the land use of Shahdara Town, Lahore, according to which the major portion of the city boundary consists of urban built-up that grows gradually and directly, causing the shrinkage of agricultural land along with the loss of biodiversity in the region. Urban agriculture not only provides food to meet the demands of the locals but also increases urban green infrastructure and biodiversity [38].

3.2. Selection of Study Area and Data Collection

The area selection (Shahdara Town, indicated in the box colored in black) was made after a comprehensive review of the literature of reports of the agriculture department, World Bank, and United Nation official documents to provide a detailed review of critical issues of the food cycle. The selected urban area of Lahore has a dense urban infrastructure with a congested road network, facing the rapid rate of urban expansion. There is a strong need to investigate the urban agricultural practices of locals, food security, related issues, and other environmental scenarios, including the impacts of urbanization on land use for the development of cities and countries.

Rapid urban expansion accelerates the rate of urbanization, making this area the most suitable for this study. A well-planned and designed questionnaire was prepared to collect firsthand information regarding the interviewers’ food security issues, local agricultural practices, and socio-economic profiles.
A pilot survey was conducted to test household background knowledge regarding urban agriculture and collect the necessary information about ground realities. On the other hand, required secondary data were obtained from different sources (Punjab Agriculture Department, Punjab Horticulture Department) to support and supplement the research and analyze different situations regarding agriculture, including the Punjab Bureau of Statistics. Among these notable sources for the provision of data are the District Agriculture Department Lahore, the District Census Reports of Lahore, agricultural statistics of Pakistan, the district revenue department, and agricultural statistics of District Lahore.

3.3. Data Analysis

The data analysis examines the questionnaire with linear regression techniques using the dependent variable (monthly income) and independent variables (consumption per month and quality of food). These analyses provide a picture of the food security situation through the regression coefficients. Regression analysis was performed using Statistical Software for Social Sciences (SPSS) version 23. At the same time, second portion of data analyses consists of GIS 10.3.2 measurements to check the impact of urbanization on land use of area under examination. Supervised classification by making different classes, including water bodies, barren land, agricultural land, and settlement area was performed by using R S data downloaded from the United States Geological Survey (USGS) website (www.usgs.gov) and put into ERDAS-IMAGINE 2014 for classification and area calculation to provide the maps of land use of the study area. For area calculation, the study uses ArcMap 10.3.1 software and describes in percentages to quantify the impact of urbanization on local biodiversity and natural land.

4. Results

The study found that food security is a significant issue not only in this study area but worldwide, especially in the urban and peri-urban areas of developing countries that face very high rates of alteration in land use and land cover change due to rapid urbanization. This is the same for Pakistan, along with other South Asian developing nations. Where the agricultural industry and food system are critical due to regional climate change, local policies, and poor agricultural development and related practices in the area. Table 1 shows the result of the assessment for food security and urban agricultural production of the study area, Shahdara Town, for basic food items that were considered major food products for urban agriculture in the area.

<table>
<thead>
<tr>
<th>Agriculture Products in Study Area</th>
<th>Production Ratio in Percentage</th>
<th>Consumption Ratio in Percentage</th>
<th>Selling Ratio</th>
<th>Total (Production, Consumption, and Selling)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs</td>
<td>36.3</td>
<td>24.2</td>
<td>6.8</td>
<td>69%</td>
</tr>
<tr>
<td>Vegetables</td>
<td>26.2</td>
<td>15.4</td>
<td>5.6</td>
<td>79%</td>
</tr>
<tr>
<td>Meat and poultry</td>
<td>7.8</td>
<td>17.3</td>
<td>15.5</td>
<td>68%</td>
</tr>
<tr>
<td>Fruits</td>
<td>6</td>
<td>100</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 1 expresses the results of the production ratio of agricultural products in the form of production, consumption, and selling ratio, as hypothesized above for regression analyses. Among these agricultural products, the production ratio of eggs and vegetables is high, at 36.3% and 26.2%, respectively. The total ratio means the total consumption plus the sale of food items.

Table 2 shows the major types of urban farming, of which kitchen gardening has the highest proportion, along with domestic livestock. Meanwhile, fruit and flower production have the least. The highest percentage of respondents, 80%, own the land where they own.
practice urban farming, while 20% of the land is on lease of various sizes, ranging from 0.0625 to 0.0125 acres. A considerable percentage of 40% of farmers kept livestock, including dairy and poultry. Some farmers had 6% and 5% fruit and flower production, respectively.

Table 2. Types of urban farming within the urban area of Shahdara Town, Lahore.

<table>
<thead>
<tr>
<th>Types of Farming</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen garden</td>
<td>47%</td>
</tr>
<tr>
<td>Fruit production</td>
<td>6%</td>
</tr>
<tr>
<td>Domestic livestock (milk, eggs, etc.)</td>
<td>40%</td>
</tr>
<tr>
<td>Flowers production</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 3 shows the regression results, where the value of 0.857 shows a positive correlation between the dependent and independent variables. Similarly, the adjusted R square value, 0.728, which accounts for 72% of this area, is strongly associated, which means that this model is suitable for peri-urban agriculture estimation.

Table 3. Regression model results summary representing the food security scenarios.

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.857</td>
<td>0.728</td>
<td>0.725</td>
<td>1.060</td>
</tr>
</tbody>
</table>

Table 4 expresses the results of the coefficients of regression. In unstandardized coefficients, the level of significance is 0.004, the beta value is between 2.575 and 0.195, and the standard error is between 0.189 and 0.056. The significance level lies between −1 and +1, which expresses the explanatory variables as statistically significant.

Table 4. Coefficients of regression results for dependent and independent variables.

<table>
<thead>
<tr>
<th>Regression Coefficient</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted Value</td>
<td>2.66</td>
<td>4.84</td>
<td>3.68</td>
<td>0.405</td>
<td>950</td>
</tr>
<tr>
<td>Residual</td>
<td>2.799</td>
<td>1.817</td>
<td>2.876</td>
<td>1.058</td>
<td>950</td>
</tr>
<tr>
<td>Std. Predicted Value</td>
<td>2.509</td>
<td>2.882</td>
<td>0.000</td>
<td>1.000</td>
<td>950</td>
</tr>
<tr>
<td>Std. Residual</td>
<td>2.642</td>
<td>1.714</td>
<td>0.000</td>
<td>0.998</td>
<td>950</td>
</tr>
</tbody>
</table>

Table 5 shows how the residual statistics predicted the value: the minimum value is 2.66, the maximum is 4.84, the mean is 3.68, and the standard deviation is 0.405. In the residual, the minimum value is 2.799, and the maximum is 1.817. The mean and standard deviations are 2.876 and 1.058, respectively, which means the statistical results are acceptable.

Table 5. Residuals statistics of regression assessment.

<table>
<thead>
<tr>
<th>Regression Coefficient</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
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</tr>
</tbody>
</table>

The results in the above table express that the rate of agricultural production is decreasing gradually over time. In 2001, agriculture production was recorded at 50%.
Meanwhile, in 2008 and 2015, this percentage decreased to 46% and 40%, respectively. In 2018, agriculture production was at 34%. The production ratio is decreasing due to the conversion of agricultural land into residential areas, which reduces arable land, as shown in Figure 1 in the land use classification maps of the study area.

Figure 2 shows the temporal variation year-wise of agricultural production. According to the results, a remarkable decrease has been observed from 2001 to 2020, which is more than half of the total production. The major reason for this is urbanization and changes in regional weather patterns that are indirectly related to climate change, biodiversity loss, and population growth.

![Agriculture percentage of different years in Shahdara Town, Lahore.](image)

Table 6 shows the land use classification of Lahore for different years, including the years 2001, 2008, 2015, and 2020. In 2001, agricultural land accounted for 50%, the built-up area was 12%, and the barren land was 34%. In 2008, land use classification showed a decrease in agricultural land to 46%. The built-up area was 14%, and the barren land was 33%. In 2015, agricultural land accounted for 40%, the built-up area was 22%, and the barren land was 36%. In 2020, agricultural land classification was 34%, built-up area was 42%, and barren land was 22%. The built-up area increased, while the barren land and agricultural land decreased.

### Table 6. Land use classification of study area Shahdara Town, Lahore.

<table>
<thead>
<tr>
<th>Years</th>
<th>Agricultural Land</th>
<th>Barren Land</th>
<th>Built-up Area</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>50%</td>
<td>34%</td>
<td>12%</td>
<td>4%</td>
</tr>
<tr>
<td>2008</td>
<td>46%</td>
<td>33%</td>
<td>19%</td>
<td>2%</td>
</tr>
<tr>
<td>2015</td>
<td>40%</td>
<td>36%</td>
<td>22%</td>
<td>2%</td>
</tr>
<tr>
<td>2020</td>
<td>34%</td>
<td>22%</td>
<td>42%</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Impacts of Urbanization on Agricultural Land**

This study analyzes the changes in land use over time to quantify urbanization and its impact on land and agriculture. For this, the study examines the land use and land cover change for 2001 by making different classes: water bodies, settlement areas, agriculture, and barren land.

Figure 3 shows the percentage of land use characteristics, which shows that the area (Shahdara Town, indicated in the box colored in black) has the highest percentage of
agricultural land, 50%, and 34% of barren land for 2001. The percentage of built-up area is 12% of the total, along with 4% water bodies of total area in 2001. This map will provide a base from which the study will further examine the impacts of urbanization on land use changes through the classification of the study area with temporal variations in different time series, for example, from 2001 to 2020. The trends of urbanization in Lahore city impact all parts of the city, including the study area, Shahdara Town.

Figure 3 shows the percentage of land use characteristics, which shows that the area (Shahdara Town, indicated in the box colored in black) has the highest percentage of agricultural land, 50%, and 34% of barren land for 2001. The percentage of built-up area is 12% of the total, along with 4% water bodies of total area in 2001. This map will provide a base from which the study will further examine the impacts of urbanization on land use changes through the classification of the study area with temporal variations in different time series, for example, from 2001 to 2020. The trends of urbanization in Lahore city impact all parts of the city, including the study area, Shahdara Town.

Figure 4 shows the percentage of land use characteristics for 2008 for Shahdara Town, Lahore (Shahdara Town, indicated in the box colored in black), as the rate of urbanization in this area continues to increase, as in the case of the developing world. Following this, the percentage of agricultural land for 2008 is 46%, which decreased from 50% to 16% from 2000, and the percentage of barren land is 33%. The percentage of built-up areas is 19% of the total area, which was 12% in 2001. While water bodies make up 2% of the total area, as calculated by the land use classification of Lahore in 2008.

Figure 5 shows the results of the land use classification for 2015 of Shahdara Town, Lahore, where the percentage of agriculture and vegetation is 40% and the percentage of barren land is 22%, which marks a decrease from previous years. Meanwhile, the percentage of built-up area is 36% of the total area, and water bodies made up 2% of the total area in 2015. The same trend of increasing the built-up area and loss of natural land can be seen in Figure 1 for 2020. The variation in land use classification from 2001 to 2020 in the figures provides forceful evidence of the impacts of urbanization on natural land by converting the natural land cover into urban built-up areas. Based on these values, the conclusion was made for sustainable urban planning and management. The urbanization rate is still increasing gradually due to high migration from rural and peri-urban or urban areas. This high rate of urbanization threatens resource distribution and food availability and causes the loss of biodiversity.
Figure 4. Land use classification of Shahdara Town, Lahore, for 2008.

Figure 5. Land use classification, Shahdara Town, Lahore, for 2015.

The results investigate the urban agriculture and its economic, social, and environmental role in sustainable urban development. Basic agriculture food items, including eggs, fruits, vegetables, milk and dairy products, meat, and poultry, are considered the product of urban agriculture to investigate their production consumption and selling ratio. The results show that in this area, the most common agriculture products are domestic livestock (40%), kitchen gardening (74%), fruit production (6%), and flower production (5%). Finally, it is concluded that there is a strong need for urban and peri-urban agriculture to provide sustainable food and food security to achieve the goals of sustainable urban development and urban sustainability for regional corporations.

5. Discussion

Urban, or peri-urban, agriculture is a type of farming within urban boundaries at the local-to-regional level to grow food on a small scale [39,40]. Along with agriculture, it involves the development of green infrastructure in a city or city boundary landscape,
Our study investigated whether urban/peri-urban agriculture is a fundamental part of the food cycle to meet the demands of growing populations over the globe, particularly in mega-cities where population growth and migration rates are high. However, due to the diversity of urban and peri-urban agriculture, possible and definite contributions to sustainable urban food systems may vary from region to region and area to area, as the region landscape’s character and climate vary from every place [43]. An important aspect of the discussion on urban or peri-urban agriculture is the number of agricultural products in an agricultural system within urban or peri-urban fringes [44]. Our study demonstrated that, around the world, in the current scenarios of urbanization, where urban areas receive a high number of challenges due to overpopulation and extensive utilization of natural resources, UA is a key environmental parameter to meet the demands of food at the local-to-regional level and platform green infrastructure to meet the city landscape. These environmental services include green urban areas and food products for the citizens as part of agriculture. It is not an activity to feed the people. It is also a social, economic, and physical activity to engage the people and sustain the local environment of an urban or peri-urban area [41]. As it provides a platform for physical activity, it is a platform for social gatherings and green infrastructure for city development [42]. However, there is still a dire need for research and other investigations on urban and peri-urban agriculture to define it in a more precise way at the regional-to-local level or even the global scale, with varying regional to local landscapes and socio-economic conditions of an area [43,44].

Our study found that, over the last three decades in Shardara Town (a peri-urban area), the migration patterns and rates have been very high because people move towards the city and settle in the city fringes, which was proven by the past study [45]. Still, there has been no forceful progress in the agricultural production ratio, which has led to poor management of natural resources in the area [46]. A lack of planning in land use in the low-developed region, including Shahdara Town, also negatively impacts the agricultural land in the area, where nearby settlement regions are merging into an urbanized area of Lahore, Pakistan. On the other hand, natural phenomena are also impacting the production ratio, for example, changes to the monsoon rainfall cycle in the region [47].

In recent years, urban agriculture has become a crucial issue for urban planners [48]. For example, its planning and science to reduce food insecurity in the domestic community [49]. Urban agriculture is still ambiguous for developing states [50]. Although the urban agriculture system is both valuable and a contributing platform for sustainable urban food systems.

Urban agriculture is a promising solution for the growing demand for food in least-developed states where the population growth rate exceeds the carrying capacity of local land. However, the equal distribution of food globally is also an important political issue, for example, in Africa, where demand is high and provision of food is low. The distribution pattern of food in developing states indicates that various social groups and individuals in low-income groups cannot access food to meet their demands. Food produced by urban agriculture is usually sought by people involved in agriculture in their gardens and lawns, which are very small in quantity. Therefore, the results revealed that the urban population should encourage participation in agricultural activities at a possible level to meet the growing demands for food and minimize the challenges of food provision for urban development and sustainability.

A limitation of this research is the nonavailability of the data at the local level. However, the study extracted the data associated with the study area from reports obtained from the Punjab Agriculture Department for the whole of Lahore City, and then the data were filtered to obtain the associated data with the study area for further analyses. This study will provide a road map for such studies in future for least-developing nations to investigate the challenges to finding their solution for the well-being of human society and its association with urban and peri-urban agriculture. The results also provide direction for sustainable agriculture to meet the demand for food in the major cities, which will help achieve the UN-SDGs.
6. Conclusions

This research concludes that urban agriculture has become an essential part of the food system for an urban area, particularly for low-income families, primarily those living at the city edges, with poor living standards to meet their demands. The role of urban agriculture in food security is significant because it provides food, vegetables, and fruits for consumption, selling, distribution, and marketing to earn profits. Urban agriculture also provides a platform for income and employment, which is a significant part of food security and economic stability in the area, along with the provision of jobs to locals. As observed during the research, producers or farmers grow the food that employs them and even their families. They use this food for survival and also for selling and marketing to generate income and profit, which indirectly improves their quality of life.

The results concluded that there is a need to encourage the local population and introduce the smart concept of urban agriculture for food security to overcome the issues of food insecurity in urban areas. This can be achieved by introducing new agricultural practices at local ground-root levels, such as tillage and drip irrigation, which also save water. There is a strong need to promote and encourage the local population, particularly the uneducated or local farmers. They should become involved in agricultural production in small or household sectors, in urban farming, and agriculture to grow more food at a high production ratio to meet the demand of the local population. This can be obtained by providing agricultural machinery to the farmers and fertilizers with subsidies to encourage the farmers to increase their cultivation practices and agricultural area. Finally, food security is the most significant part of a sustainable food and life cycle. Hence, a substantial need exists to promote urban agriculture to overcome food insecurity issues, biodiversity loss, and air pollution in urban areas.

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